Endogenous Choice of Firm Size and the Structure of Wages: A comparison of Canada and the United States

Stéphanie Lluis [1]
University of Minnesota[2]

This version: June 2003

[1]I thank John Budd, Matthew Doyle, Ana Ferrer, David Green, Jennifer Hunt and Thomas Lemieux for valuable comments. Financial and logistic support by the University of British Columbia is gratefully acknowledged.

[2]Industrial Relations Center, 321 19th Avenue South, Minneapolis, MN 55455, USA. Tel: (612) 624-4171, email: slluis@csom.umn.edu, Fax: (612)-624-8360.

Abstract

This paper compares the Canadian and U.S. wage structures by firm size. The objective is to test for the possibility of different returns to education and experience as well as examine the role played by unmeasured skills in driving the allocation of workers across firms of different sizes. Those effects may arise if large and small firms have different working environments in which the various dimensions of workers' skills (measured and unmeasured) may not be identically productive. The analysis is performed separately for the samples of unionised and non unionised workers in order to isolate any effects of unions on the size-wage structure.

The results show evidence of non random selection of workers into firms of different sizes for both countries in both sectors. In the non unionised sector, the selection is found to be strongly negative in large firms in both countries and positive in small firms. The observed selection pattern implies that workers in large firms would be on average of lower quality in terms of unmeasured aspects of skills whereas those in small firms would be of higher quality. In addition, a decomposition of the size-wage gap shows that large firms tend to put more weight on the valuation of measured skills (education and experience) than small firms do. This pattern is robust to controlling for self selection, and in fact, once selectivity effects are incorporated it appears that rewards to measured skills constitute the main source of higher wages in large firms. This finding combined with the result on the selection pattern is consistent with an explanation of the differences in wage policies between large and small firms based on differences in monitoring costs.

Finally, a comparison of the results for unionised and non unionised workers shows the similarity in the selection pattern in both sectors for both countries. The similarity implies that the non random selection of workers into large and small employers seems to operate independently of the non random selection associated with union and non union status.

KEYWORDS: Firm Size, Wage Structure, Non Random Selection, Education, Unmeasured Skills.

JEL CLASSIFICATION: J24, J31, J51.

1 Introduction

A largely documented stylised fact in the empirical literature on wage determination is that large firms pay more than small firms for observationally equivalent workers. The estimated size-wage premium is about 15% in the United States and 10% in Canada. Empirical studies that investigate the source of this wage differential have analysed the explanatory power of various factors related to workers and firm characteristics such as education, unionization and industry type.[1] Although some of these factors contribute to reducing the size-wage premium, none can fully explain the gap and there remains a significant unexplained wage premium for workers in large firms. Furthermore, controlling for unobserved individual heterogeneity using fixed-effects does not significantly reduce the estimated size-wage premium.

The methodology used in these studies consists of estimating a standard Mincer wage equation augmented by variables on firm and/or establishment size. This approach does not allow for the possibility that human capital attributes may not be equally valued in large and small firms. Large and small firms have different working environments in which the various dimensions of workers' skills (measured and unmeasured) may not be identically productive. For instance, large firms present more opportunities for promotion and career development which may attract workers with high unobserved ability. Ability would then play an important role in sorting workers into positions leading to individual wage differences based on unmeasured aspects of skills.[2] On the other hand, measured and unmeasured aspects of skills may be valued differently by large and small firms due to differences in monitoring costs. Larger firms may have high costs of monitoring and may prefer to reward skills that are directly observable (like education and experience) relative to small firms.[3] These kinds of effects can result in different returns to both measured and unmeasured dimensions of human capital between large and small firms although it is not clear, a priori, what the overall effect on wage profiles in small versus large firms ought to be.

This paper analyzes whether and to what extent firms of different sizes have different wage structures. The objective is to study the possibility that firm size affects wages through the non random selection process of workers into firms of different size. The paper concentrates on

[1] See Oi and Idson (1999) for a review of the literature on firm size and wages in the U.S. and Morissette (1993) for a study of the Canadian case.

[2] See Gibbons (1998) for a review of the empirical literature on wage dynamics within organizations and evidence of fast-tracks. Reilly (1993) finds that controlling for computer access significantly reduces the impact of establishment size on wages which suggests that unobserved dimensions of human capital may play an important role in explaining differences in wage outcomes across firms of different sizes.

[3] See Garen (1985) for a theoretical model exhibiting this prediction.

Canadian and U.S firms, using cross-sectional data from the Labour Force Survey for Canada and the March Current Population Survey for United States for the year 1998.

Persistent size-wage gaps, as well as different wage profiles by firm size, can coexist with competitive labour markets if workers sort themselves into firms of different sizes based on unobserved (to the econometrician) characteristics. The statistical framework in this paper is based on a Roy model [4], in which different skills (measured and unmeasured) are not equally productive in small and large firms. Utility maximizing workers, in this framework, choose the size of employer for which their abilities are best suited. This results in a particular distribution of skills across firms of different size and in different wage structures by firm size. This paper estimates such a model and tests whether the predicted differences in wage structure by firm size can be found in the data as well as whether or not the underlying mechanism of self selection based on unobservables provides a good explanation of any such differences.

The existing literature has found size-wage gaps in both Canada and the U.S. As a result, it is interesting to investigate whether wage profiles by firm size are also similar in both countries. However, in undertaking this exercise, it is important to note that there may be some important differences between labour markets in Canada and the U.S. In particular, unions exert more influence over the labour market in Canada than is the case in the United States (Freeman (1980), DiNardo and Lemieux (1997)). How might this impact the wage structures of small and large firms? Unions tend to reduce the part of the remuneration that reward individual measured and unmeasured skills (Lemieux 1993), and are more concentrated in large firms (Maranto (1988) and Martinello and Meng (1992)). As a result of these effects, it is important to allow for the possibility of different size-wage effects in unionised and non-unionised firms.

Idson and Feaster (1990) analyze the size-wage premium correcting for worker self-selection applying a similar framework to a sample of U.S firms drawn from the 1979 May CPS. Although their analysis focuses primarily on improving estimates of the size-wage gap, they briefly present some results which support the idea that firms of different sizes have different wage policies in which measured and unmeasured skills are differently rewarded. They also find evidence of non random selection. That is, that an unobservable or unmeasured trait drives workers' choices between working in large or small firms. As it is not their main interest, Idson and Feaster do not investigate their findings on differences in wage structure by firm size in any detail. Furthermore they restrict their attention to non-unionised firms.

[4] See Roy (1951) for the motivation of the model and Neal and Rosen (1998) for more details on selection models and their implications for earnings distribution.

Pearce (1990) analyzes differences in the returns to tenure among large and small employers as well as the role of unions in influencing the employer-size wage relationship. Also using data from the CPS of May 1979, he finds evidence of a smaller size-wage gap in the union sector and of steeper tenure profiles in larger employers where workers are not unionised. His analysis however does not consider the possibility that workers endogenously choose the size of the firms for which they work and the resulting self-selection of workers into employers of different sizes.

The paper is organised as follows. Section 2 describes the data and presents a cross-country analysis of the size-wage gap in the same spirit as the existing literature. Section 3 describes the framework of analysis based on a model of non random allocation of workers into firms of different sizes and presents the estimation method. Section 4 presents the results and section 5 concludes the paper.

2 Data

This section presents the variables and sample selection procedures used for the LFS and the March CPS.[5] It also compares the size-wage gaps for the two countries estimated according to the methodology used in the existing literature.

2.1 Variables and Sample Selection

Whenever possible, variables in both data sets are defined similarly. Since education is reported categorically in both surveys, the following four categories are utilised: university, post secondary, secondary and no diploma for Canada, and for the U.S., college, associate college, high school and less than high school.[6] Because age is reported categorically in the LFS, dummies for age are used for both countries. Other variables similar in both data sets include gender, race, marital status, occupation and industry dummies. For firm size, a dummy indicating that the firm has more than 500 employees at all locations has been created to define large firms for both countries.

[5] Descriptive statistics on the main variables used in the two data sets are presented in Appendix Tables A1.a and A1.b respectively.

[6] For Canada, the "no diploma" category includes individual reporting partial secondary or without diploma. In the CPS, the category "associate college" corresponds to associate degree-occupational/vocational or associate degree-academic program. Also individuals reporting some college but no degree are included in the "high school" category.

The main difference between the two surveys is that the LFS provides information on establishment size in addition to firm size. Given that both variables may have a different impact on wage outcomes, the information on establishment size will be used for Canada in parallel with the cross-country analysis. The LFS also contains worker's tenure in his/her current job which is not available in the March CPS survey. Potential experience will be used instead for cross-country comparisons. Finally, wages are given on an hourly basis for all workers in the LFS. Hourly wages are computed for the U.S. based on the information on usual hours worked per week. [7]

The final sample consists of individuals aged between 20 and 65 working full-time. I have excluded the self-employed as well as workers in the construction for which firm size effects are not relevant. The number of observations is 69521 for Canada and 28117 for the United States.

2.2 Employer-Size Wage Differentials

Recent empirical studies on the determinants of wage and wage growth have analysed possible departures from the basic Mincer-type wage equation that includes education and a quadratic in experience. Since the wage equation is originally derived from a model of optimal investment in human capital, it does not offer a complete representation of the labour market as it only describes the supply side of the market. These studies add variables that describe and capture variations in wages related to the demand side of the labour market to the wage equation. In particular, industry, occupation, unionization and firm size dummies are the main variables employed.

This section presents the results of a cross-sectional OLS estimation of employer-size wage differentials for the two countries in the spirit of the empirical literature on firm size and wage outcomes. I replicate the estimation of the size-wage gap using data from the LFS and CPS for 1998 by regressing the log of wages on a dummy variable characterizing large firms and adding control variables to see how they affect the magnitude and significance of the coefficient on firm size. Results for both countries are reported in Table 1, columns (I) to (V). Note that for Canada, columns (VI) and (VII) show the results with additional controls for establishment size and worker tenure.

[7] The CPS contains several questions related to hourly, weekly or yearly wages. I have combined the information from the three different sources to compute hourly wages. For individuals reporting only yearly wages, I divided wages by 51 weeks times the reported number of usual hours worked per week.

Overall, the results are similar to those found previously in the literature on the size wage gap. Column (I) shows the average size-wage gap in the absence of worker or firm controls. The coefficient associated with the dummy for large firms (more than 500 employees) gives a wage differential of 0.20 for Canada and 0.24 for the U.S. In terms of percentage, the difference in wages between large and small firms is 22.1% for Canada and is 27.9% for the United States. [8] The coefficients are similar to those estimated in Morissette (1993) using the Canadian Labour Market Activity Survey (LMAS) for 1986 and in Oi and Idson (1999) who use the May 1983 CPS. This suggests that the magnitude of the gaps has not changed over time in either country.

Column (II) presents the results when education and experience are added to the log wage equation. The size of the coefficients associated with firm size drops substantially for both countries compared to column (I) revealing that part of the size wage gap can be explained by human capital differences across workers employed by large and small firms.

Introducing the effect of union membership [9] in column (III), does not change the size-wage premium in the U.S. case, whereas the gap is substantially reduced in Canada. The addition of industries and occupations (columns (IV) and (V)) reduces the effects of firm size leaving an estimated wage differential of 0.076 (7.9%) for Canada and 0.133 (14.3%) for the U.S.. Note that the addition of worker and firm characteristics reduced the size wage gap for Canada by about 65% (compared to column (I)) whereas the same types of controls reduced the U.S. gap by about 46%.

Columns (VI) and (VII) for Canada show the effects of introducing establishment size and tenure on the size-wage gap. The coefficient associated with firm size drops substantially when establishment size is controlled for but remains significant. The introduction of a quadratic function of tenure in column (VII) reduces the impact of potential experience and slightly reduces the impact of firm size. The estimated establishment size wage gap amounts to a wage differential of 11.9%, controlling for firm size, tenure, occupation and industry. The significant impacts of both firm and establishment size is found in the U.S. case by Brown and Medoff (89).

Overall, the results for both countries are consistent with those found in the literature based on other cross-sectional data sets. After controlling for worker and firm characteristics, workers earn about 14% more in large (more than 500 employees) U.S. firms and about 8% more in large Canadian firms.

[8] These percentages corresponds to the anti-log of the regression coefficient minus one.

[9] The dummy for union membership also includes workers covered by collective bargaining agreements.

This paper considers the possibility that, in additions to paying different wages on average, small and large firms reward different worker characteristics differently. The next section presents an analytical framework based on the non random allocation of workers into large and small firms and describes the estimation method used to estimate and test these ideas.

3 Analytical Framework

The main difficulty in the analysis of wage determination is that wages are determined in an equilibrium context. Any empirical analysis, therefore, has to deal with disentangling the effects of simultaneous movements in labour supply and demand on wage outcomes. However, the literature on assignment and the distribution of earnings, first studied by Roy (1951) and later developed by Sattinger (1975, 1993), provides a mechanism by which wages do not depend on workers and firms characteristics independently, but on the value that a particular skill takes on when assigned to a particular job or firm. In this framework, workers are not identically productive across firms with production technologies that are differently sensitive to workers' skills. This paper examines the assumption that the sensitivity of the technology with respect to skills varies with the number of workers. This implies that workers are not identically productive in large and small firms.

This section describes a model of non random assignment of workers into firms of different size based on both measured and unmeasured aspects of worker skill. It then discusses the implications of the model regarding the structure of wages in firms of different sizes.

Assume there are two types of firms which differ by size. Firms are indexed by $j = S(\text{small}), L(\text{large})$. The only input is labour, given in efficiency units per worker. Workers, indexed by $i = 1, ..., N$, are characterised by a vector of productive skills, (SK_i, θ_i), where SK_i denotes observed skills and θ_i represents skills that are unmeasured by the econometrician (these could include innate ability, initiative, ambition, loyalty). The production technology of firm j exhibits constant returns to scale with respect to labour: [10]

$$Q^j = \sum_{i=1}^{N^j} n_i^j (SK_i)^{\alpha_j} (\theta_i)^{\beta_j}, \; j = S, L \tag{1}$$

where N^j is the total number of employees in firm j and n_i^j is the number of employees of in

[10] It is assumed that firms of different size have different production technologies in terms of the sensitivity to the skills required. The fact that both have constant returns to scale simplifies the analysis. Other assumptions on returns to scale would involve finding the optimal size for both firms which is beyond the scope of this paper.

firm j endowed with (SK_i, θ_i). There is one output the price of which is normalised to one. The profit maximizing condition for both types of firms implies the following conditions on the marginal product of workers with skills (SK_i, θ_i):

$$w_i^j = \frac{\partial Q^j}{\partial n_i^j} = (SK_i)^{\alpha_j}(\theta_i)^{\beta_j} \tag{2}$$

The wage offered by large and small firms will therefore be, in log form:

$$lnw_i^L = \alpha_L lnSK_i + \beta_L ln\theta_i, \text{ for large firms} \tag{3}$$

$$lnw_i^S = \alpha_S lnSK_i + \beta_S ln\theta_i, \text{ for small firms} \tag{4}$$

On the workers' side, it is assumed that workers skills (SK_i, θ_i) are exogenously given so that investment in human capital is ignored. Workers are utility maximizers and the utility associated with working in a large or small firm is assumed to depend on firm attributes that are size-specific such as the wage rate and the working environment.

Workers choose to work at a large (small) firm because they have a comparative advantage in that type of firm. Let V_i^j denote the (indirect) utility of working in a firm of size j. Define Z_i as a vector of individual characteristics that affect the utility of being in a large (or small firm), the indirect utility function of worker i is given by:

$$\begin{aligned} lnV_i^j &= \psi_0 + \psi_1 lnw_i^j + \psi_{2j} Z_i \\ &= \psi_0 + \psi_1 \alpha_j lnSK_i + \psi_{2j} Z_i + \psi_1 \beta_j ln\theta_i, \quad j = L, S \end{aligned} \tag{5}$$

where (5) results from substituting the wage equation offered by large or small firm into equation (8).

A worker chooses to work at a large firm if his utility is maximised by such a choice, that is if $V_i^L > V_i^S$. Utility is not directly observed but the net gains associated with the choice of, let's say, a large firm is represented by:

$$lnV_i^L > lnV_i^S \quad \leftrightarrow \quad \psi_1(\alpha_L - \alpha_S) lnSK_i + (\psi_{2L} - \psi_{2S}) Z_i + \epsilon_i > 0 \tag{6}$$

where $\epsilon_i = \psi_1(\beta_L - \beta_S) ln\theta_i$ is an individual specific term affecting utility. Representing the net gain from choosing a large firm by the latent variable U_i^*, a worker's assignment into a

large or small firm corresponds to the following conditions:

$$\begin{aligned} \text{Worker } i \text{ chooses L} &\leftrightarrow U_i^* > 0 \leftrightarrow \phi_1 lnSK_i + \phi_2 Z_i + \epsilon_i > 0 \\ \text{Worker } i \text{ chooses S} &\leftrightarrow U_i^* \leq 0 \leftrightarrow \phi_1 lnSK_i + \phi_2 Z_i + \epsilon_i \leq 0 \end{aligned} \tag{7}$$

where $\phi_1 = \psi_1(\alpha_L - \alpha_S)$ and $\phi_2 = \psi_{2L} - \psi_{2S}$. The assignment of workers into firms of different size and the wages received will therefore be given by the following allocation rule: A worker with endowment (SK_i, θ_i) chooses a large firm if and only if:

$$U_i^* > 0 \quad \leftrightarrow \quad ln\theta_i > g(lnSK_i, \phi_2/\phi_1 Z_i)$$

This inequality defines the conditional distribution of the worker's innate ability, θ_i, given SK_i across firm size.

This framework emphasizes the notion that different workers have different comparative advantages in firms of different sizes. This idea is relevant when analyzing the returns to skills across firm size and the role of unmeasured aspects of skills in driving the workers' allocation into firms of different sizes. The current empirical literature, however, has not yet analysed and questioned the importance of this idea in explaining the size-wage relationship. The next section presents the estimation method used to test the possibility of different wage structures by firm size and the role of unmeasured ability.

3.1 Estimation Method

The framework introduced in the previous section corresponds to a switching regression model with endogenous switching that can be summarised by the following set of equations: [11]

$$lnw_i^L = X_i\gamma_L + u_{iL} \tag{8}$$

$$lnw_i^S = X_i\gamma_S + u_{iS} \tag{9}$$

$$U_i^* = W_i\delta + \epsilon_i \tag{10}$$

$$\begin{aligned} \text{where } u_{iL} &= \beta_L ln\theta_i \\ u_{iS} &= \beta_S ln\theta_i \\ \epsilon_i &= \psi_1(\beta_L - \beta_S) ln\theta_i \end{aligned} \tag{11}$$

[11] See Maddala (1983) for a review of switching regression models.

The matrix X stands for workers' measured human capital such as education, a quadratic function of experience, marital status, gender and race. It also contains dummies for occupation, industry and large city to control for compensating wage differentials. W contains the variables in X as well as the variables in Z which affect the selection process. Distributional assumption on the vector of error terms and the correlation between u_{iL}, u_{iS} and ϵ_i define the selectivity term, commonly called the inverse Mills ratio, to be added to the wage equation. More precisely, denote by $\sigma_{\epsilon L}$ and $\sigma_{\epsilon S}$ the covariance between ϵ and u_{iL} and u_{iS} respectively. Assuming normality of the vector of error terms defined in (11), the mean wage of workers in large (small) firms given that they chose to work in a large (small) firm is:

$$\begin{aligned} E[lnw_i^L | U_i^* > 0] &= X_i\gamma_L + E[u_{iL} | \epsilon_i < W_i\delta] \\ &= X_i\gamma_L + \sigma_{\epsilon L}\,\frac{\phi(W)}{\Phi(W)} \qquad (12) \\ E[lnw_i^S | U_i^* \leq 0] &= X_i\gamma_S - \sigma_{\epsilon S}\,\frac{\phi(W)}{1-\Phi(W)} \qquad (13) \end{aligned}$$

Significant estimates of $\sigma_{\epsilon L}$ and $\sigma_{\epsilon S}$ can be interpreted as evidence of non random selection of workers into large and small firms. Although the magnitude of the covariances does not have a direct interpretation, their sign reflects the selection process. Given that the selection equation characterizes the choice of large firms, positive selection into large firms corresponds to $\sigma_{\epsilon L} > 0$ and positive selection into small firms is implied by $\sigma_{\epsilon S} < 0$. Positive selection in large firms is equivalent to saying that workers who chose to work in large firms are better than average workers in terms of unmeasured dimensions of skills. This would occur if large firms assign positive reward to these unmeasured skills. [12] The reasoning is equivalent for small firms.

An advantage of this framework is that it does not impose restrictions on the direction of the selection of workers into firms of different size. That is, the covariances $\sigma_{\epsilon L}$ and $\sigma_{\epsilon S}$ can be of similar or opposite signs implying either positive selection in both large and small firms ($\sigma_{\epsilon L} > 0$ and $\sigma_{\epsilon S} < 0$) or positive (negative) selection into large firms and negative (positive) selection in small firms corresponding to $\sigma_{\epsilon L} > 0$ ($\sigma_{\epsilon L} < 0$) and $\sigma_{\epsilon S} > 0$ ($\sigma_{\epsilon S} < 0$). [13] A test of differences in the wage structures between large and small firms in terms of evaluation of unmeasured skills requires $\sigma_{\epsilon L}$ and $\sigma_{\epsilon S}$ to be significant in both wage equations and to have

[12] Negative selection has the opposite interpretation. In this case, large firms would not assign a positive reward to unmeasured aspects of skills.

[13] The case where $\sigma_{\epsilon L} < 0$ and $\sigma_{\epsilon S} > 0$ is not possible by definition of $\sigma_{\epsilon L}$ and $\sigma_{\epsilon S}$. See Maddala (1977a) for details.

identical signs.

The estimation is performed using the Heckman two-step method as follows. In a first step a probit model is used to estimate the probability that a worker chooses a large firm and computes the resulting inverse Mills ratio. The second step estimates the wage profiles augmented by the inverse Mills ratio. The resulting estimations provide information on the potentially differential effects of education and experience on wages in small and large firms as well as on the effect of the inverse Mills ratio in each case. In this paper, the inverse Mills ratio has an interpretation that goes beyond the so-called selectivity term because by the definitions given in (11), it provides a proxy for unmeasured individual-specific ability θ_i.

Identification of the coefficient associated with the inverse Mills ratio in the wage equation is obtained through nonlinearities implied by the use of the normal distribution for the estimation. Using all the explanatory variables in the wage equation as explanatory variables in the probit selection equation implies non linearities that allows identification of the inverse Mills ratio in the wage equation. For that matter, the vector Z_i defined earlier is composed of the set of explanatory variables X_i usually employed in the wage equation. [14]

Exclusion restrictions can also be used for identification of the parameters. This method consists in choosing variables that affect the selection process but do not directly affect the worker's individual wage. A variable that satisfies the exclusion restriction would be correlated with the worker's choice of firm size without directly affecting the worker's wage. As a possible variable satisfying these requirements, I use interactions between the worker's industry and city size.

Table 2 below shows that there is a positive correlation between firm and city size, suggesting that large firms are commonly found in large cities and small firms in small cities. There is, however, substantial variation in this correlation across different industries. This suggests that a worker living in a large city would on average be more likely to find work in a large firm (than a worker in a small city). The chances of such a worker finding work in a large firm, however, would vary with the worker's industry. This suggests that interacting industry and city size would be useful as a predictor of firm size, over and above the information contained in city size or industry considered independently.

[14] The variables in the wage equation are education, a quadratic in experience, gender, marital status, occupation and industry and city size.

Table 2: Correlations of Firm Size with City Size Worked[a]

Correlation Coefficients[b]		Canada Large Firm	United States Large Firm
Large City		0.017***	0.052***
Large City by Industry:			
	Primary	0.020	0.036
	Durables	-0.099***	-0.193***
	Non Durables	-0.052***	0.023
	Transport	0.104***	0.149***
	Trade Wholesale	0.033	0.091**
	Trade Retail	0.097***	0.010
	Finance	0.037*	0.127***
	Services	-0.003	0.053***
	Civil Service	0.021	0.118***

a-Firm size is defined as a dummy for firms with more than 500 employees. City size is defined as a dummy equal to one for more than 500 thousands individuals in the U.S. case and for Vancouver, Toronto and Montreal in Canada.
b-***= 1% level, **= 5% level, *= 10% level of significance.

In order to be valid as an exclusion restriction, the interaction of industry and city size must meet the further condition of having no direct effect on wages. It is well known that there are wage premia associated with industry (Dickens and Katz 1987, Krueger and Summers 1988) as well as an urban wage premium (Glaeser and Maré (2001)). There is no reason, however, to expect that the urban wage premium should depend on industry. In other words, it seems reasonable to think that a worker in the transportation sector living in a large city would earn the same urban wage premium as a worker in the services sector living in a large city.[15]

Appendix B attempts to test the reasonableness of this assumption. The results of the test suggest that, in fact, the urban wage premium is the same across most industries.[16]

[15]This would be the case if the urban wage premium was the result of compensating differentials reflecting the higher costs of living in a large city and other urban disamenities.

[16]Interestingly, the test suggests that where there are differential urban wage premia by industry, they occur in the durable and non-durable sectors in Canada and the non-durable sector in the U.S. These are exactly those sectors in which the correlation between city and firm size is significant and negative. The results reported on section 4.2 are largely robust to including the interactions associated to these particular industries in the wage equations though the significance of the selectivity terms is weakened.

4 Results

This section presents the results of the analysis of the size-wage structure in three parts. In section 4.1, the possibility of different returns to skills by firm size is analysed using OLS estimations of hourly wages (in log) on education dummies and potential experience both interacted with a dummy indicating whether the individual works in a large firm (more than 500 employees). Tests of equality of the returns to education and experience between large and small firms are performed based on the χ^2 statistic. In section 4.2, endogeneity in firm size and the impact of workers self-selection on wage outcomes are analysed using the Heckman two-step method following the analytical framework presented in section 3. Section 4.3 further investigates the role of self-selection on the size-wage structure by studying the respective contributions of measured skills and self-selection in explaining the size-wage structure. This analysis is based on the decomposition of the size-wage gap following the Oaxaca/Blinder method. In each section, a separate analysis for unionised and non unionised workers is performed to isolate the impact of unions on the size-wage structure.

4.1 Size-wage Structure and Measured Skills

This section describes the results of the analysis of the size-wage structure for measured skills for Canada and the United States where returns to education and potential experience are estimated and a test of equality of the returns between large and small firms is performed. The results are presented in table table 3. While there is evidence of significantly different wage structures in large versus small employers in both Canada and the U.S., the wage-education and wage-experience profiles by firm size differ across countries. In the U.S., potential experience seems to be significantly more rewarded in larger employers. Staying an additional year in a large firm brings an estimated average of 3.4% increase in salary in large firms but only 2.6% in small firms. On the other hand, there is only weak evidence of significant differences in the returns to education between large and small firms. For Canada, there are no significant differences in the valuation of additional years of experience by firm size. There are however significant differences in the returns to university, post secondary and no secondary education between large and small firms. The test of the differences in returns shows a value of the χ^2 statistics of 9.97 for university and of 19.37 for no secondary education which is well above the

value of 5.4 for a test at the 1% confidence level. The percentage differential in wages between large and small firms is about 9% for workers without secondary education and about 5% for workers holding a university diploma.

It is interesting to note that the returns to holding a university diploma in Canada are lower in large than in small firms. Given the tendency for unions to compress individual wage differentials like those arising from differences in level of education, a possible interpretation for this finding is the higher concentration of unions in large firms. From the descriptive statistics of the Canadian data (shown in Appendix A1) 50.2% of large firms are unionised compared to only 27.4% of small firms. To isolate union effects Tables 4.a and 4.b replicate the analysis for both countries separately for non unionised and unionised workers respectively.

From Table 4.a, one can see that the cross-country differences in the size-wage structure mostly disappear when the sample of non unionised workers is used. In both countries, there is evidence of a different wage structure in large and small firms in that experience is rewarded more in large firms. This result suggests that firm-worker matches of higher quality tend to last longer in large firms. There are no significant differences in the way large and small firms reward education in the U.S. case and evidence of higher returns to a university diploma and lower returns to no secondary education in large (non unionised) firms in the Canadian case, with a percentage differential in wages of about 5% in each case.

The results for the sample of unionised workers, presented in table 4b, are similar to the Canadian results from table 3. This is consistent with the earlier conjecture on the impact of unions on wage outcomes in Canada. Among unionised workers, the return to holding a university diploma relative to no secondary education is significantly higher in small firms (by a 9% percentage differential in wages). Indeed, workers holding a university diploma earn on average 35.3% more than workers with no secondary education in small unionised firms while the percentage premium for university education in large unionised firms is only 25.9%. The difference earn on average The results for the U.S., although not significant given the smaller sample size [17], show similar differences in coefficients for college education between large and small firms as Canada. These results suggest that small unionised employers face

[17] The small sample size results from the fact that the March CPS survey interviews only one of the rotational groups identified in the design of the monthly CPS. For that reason, a smaller percentage of that population is unionised compared to the overall average of 20% usually observed in the literature. An analysis based on several years of the March CPS data will be performed in the rest of the paper to increase the precision of the analysis and allow comparisons with the Canadian case.

lower pressures than large ones, allowing them to maintain education wage differentials.

Overall, this first series of results shows that the size-wage structure in the non unionised sector is similar in Canada and the United States with strong evidence of higher returns to potential experience in large firms and no substantial evidence of differential returns to education in large and small firms. The significant differences found in the returns to experience between large and small firms in both countries suggests that it may be worthwhile to investigate the role that unmeasured skills may play in explaining the size-wage structure in both countries. Unionised firms exhibit different patterns. The key observation is that the estimated returns to higher education are higher in small unionised employers relative to large unionised firms. [18] The objective of the next section is to see whether these results hold when one introduces the idea of workers non random selection into large and small firms.

4.2 Size-wage Structure and Non random Selection

This section investigates the existence of non random selection in the allocation of workers into firms of different sizes. The analysis is performed separately over the sample of non unionised workers in the private sector [19] and for unionised workers. The results are presented in tables 5a and 5b respectively. The first two columns of each table give the results of separate log wage equations for large and small firms without correction for self-selection. The next two columns present the results with the inclusion of the inverse Mills ratio. [20]

For the sample of non unionised workers (see table 5a), the results for both countries are similar in terms of the sign and magnitude of the selection terms. Both terms are significant in large and small firms suggesting evidence of non random selection of workers into large and small firms. Based on the specification of the selection model and the resulting wage equations given in equations (12) and (13), in both countries there is evidence of negative selection in

[18] Note that including information on establishment size and tenure available in the LFS reduces the magnitude of the coefficients on education and experience but do not change the overall results for Canada in either the unionised and non unionised samples. The results are not shown but available upon request.

[19] Following the literature on the size-wage gap, the analysis is performed over the sample of workers in the private sector to minimize possible union threat effects that may play a role that is expected to be stronger in the public sector. Results over the sample of both private and public non unionised workers are similar to those presented in the paper. This suggests that, as in the analysis of the size-wage gap, the idea of threat of unionization does not seem to affect the size-wage structure.

[20] All these results identify the selectivity terms through the use of the exclusion restrictions. As discussed in section 3, the results are largely robust to the inclusion of some interaction terms in the wage equations, though significance of the selectivity estimates in small firms is reduced.

large firms and positive selection in small firms. This implies that workers in large firms would be on average of lower quality in terms of unmeasured aspects of skills whereas those in small firms would be of higher quality.

Table 5b presents the results for the sample of unionised workers. For Canada, there is evidence of negative selection into large firms and positive selection into small firms implying that the selection patterns are similar in both unionised and non unionised cases for Canada. [21] In the U.S. case the results for the unionised sector are generally more imprecisely estimated due to the much smaller sample size. There is no significant effect of the inverse Mills ratio in the wage equation for large firms and weak evidence of positive selection into small firms. Although the selectivity term is not significant, it is largely negative and similar to the one observed in the non unionised case. To investigate further the wage structure for unionised workers and allow comparisons with the Canadian case, I performed the same analysis over the three years of the March CPS data pooled together with controls for year dummies. The results are shown in appendix C both for non unionised and unionised U.S. workers. Interestingly, the results are very similar to the Canadian case in terms of the selection patterns.

In both the unionised and non unionised sectors, the returns to higher education fall in both countries whenever the estimation controls for self-selection. Not surprisingly given the unions compression effects the distribution of individual wages, the reduction in the education wage differentials in both large and small firms is more pronounced when the analysis is performed over the sample of unionised workers. This observation raises the question of whether important differences in the returns to education between large and small firms remain once selection is controlled for. If these differences remain, do they constitute a large part of the size wage gap compared to the effect due to the selection terms? The next subsection addresses these questions.

4.3 Size Wage Gap Decomposition

In this subsection, the possibility that large and small firms establish different wage policies with respect to workers' measured and unmeasured skills is analysed. Given the analytical

[21] When tenure is included in the estimation, tenure effects are reduced after inclusion of the selectivity term in both large and small firms wage equations. Experience effects slightly increase in large firms. The results are not shown but available upon request.

framework presented in section 3, one can interpret the inverse Mills ratios in each wage equation as proxies for any differences in the wage structure between large and small firms resulting form unmeasured aspects of skills. The objective of the analysis hereafter is to analyse the simultaneous contributions to the size-wage structure of measured and unmeasured skills. The method used to emphasized the role that each of these components plays in explaining the size-wage structure is the Oaxaca/Blinder wage decomposition. Following the Oaxaca/Blinder method, the average size-wage gap can be decomposed into the following :

$$\overline{W}_{LK} - \overline{W}_{SK} = \Sigma_K [\ \underbrace{(\overline{X}_{LK} - \overline{X}_{SK})\beta_{LK}}_{\text{Difference in Endowments}} + \underbrace{(\beta_{LK} - \beta_{SK})\overline{X}_{SK}}_{\text{Difference in Betas or Price}}\ ], \quad K = U, NU \tag{14}$$

Where $K = U, NU$ indexes the unionised and non unionised sectors respectively, $\overline{W_{.K}}$ is the average wage in large or small firms in sector K, $\overline{X_{.K}}$ is the vector of average workers' characteristics in sector K and the betas are estimated from separate ols regressions of log wages on the X characteristics for large and small firms. The first term corresponds to the part of the size-wage gap that is due to differences in the composition of the workforce in large and small firms while the second one describes differences in the evaluation of workers characteristics between large and small companies. Any differences in wage policies between large and small firms will therefore be characterised by the sign and magnitude of the second term. In addition, this type of analysis allows one to further investigate the contribution to the size-wage gap of each individual variable related to measured skills (education and experience) and unmeasured skills (the inverse Mills ratio) when the average size-wage gap is computed from the unconditional mean (including non random selection). Indeed, the previous formula can be further decomposed into the following:

$$\overline{W}_{LK} - \overline{W}_{SK} = \underbrace{(\overline{X}_{LK} - \overline{X}_{SK})\beta_{LK} + (\beta_{LK} - \beta_{SK})\overline{X}_{SK}}_{\text{Measured Skills}} + \underbrace{(\gamma_{LK}\overline{\lambda}_{LK} - \gamma_{SK}\overline{\lambda}_{SK})}_{\text{Unmeasured Skills}} \tag{15}$$

Where λ_{LK} and λ_{SK} represents the inverse Mills ratios associated with the choice of large and small firms in sector K. The idea is to see how much of the size-wage gap can be attributed to differences in the composition of the workforce versus differences in the valuation of workers skills in large and small companies and examine whether these respective contributions are affected by the inclusion of the selection effect.

The results for both countries in the non unionised private sector case are presented in table 6a where in the first three columns, the wage gap decomposition is computed without correction for self-selection. Looking first at the decomposition of the overall size-wage gap (row labelled "All") for Canada and the U.S., one can notice that whether or not self-selection is introduced, the differences in the valuation of education and experience explain a higher proportion of the gap than differences in the composition of the workforce across large and small firms. The positive signs reflect the fact that the valuation of these measured skills is higher in large firms. Consistent with the nature of the selection pattern observed in section 4.2, that lower quality workers tend to gravitate toward large firms, the results, controlling for selectivity, suggest that the actual difference in the valuation of measured skills between large and small firms is greater than implied by the estimates that ignore the selectivity effect. In other words, once the fact that large firms have workers with lower quality along unobserved dimensions is taken into account, it appears that the higher wages paid by large firms on average are due to the fact that large firms reward measured skills much more strongly than do small firms.

We can refine this decomposition so as to measure the contributions of the individual variables that represent measured skills (i.e. education and experience) and can examine the effect of controlling for self selection of workers on the estimates of these contributions. The main empirical regularity, which can be observed by comparing column 3 to column 6, is that once selectivity is controlled for the contribution of each of the measured skill in explaining the size-wage gap increases. This finding is consistent with Garen (1985) who explains differences in the returns to skills in large and small firms using a model in which higher monitoring costs in large companies lead them to reward workers based on more easily measurable skills like education or experience. The results in the present paper seem to confirm this prediction in that, after controlling for self-selection, the estimated premium paid by large firms to measure skills, education and experience, increases.

Interestingly, differences in workforce composition seem most important in explaining the size-wage gap for college educated workers and workers with no secondary schooling. For workers with intermediate levels of education, on the other hand, differences in wages (across large and small firms) seem to be driven by differences in the valuation of these skills (i.e. different wage policies). These observations are robust to, and actually exacerbated by inclusion

of controls for selectivity.

The results for the sample of unionised workers are presented in table 6b and are fairly similar to the results for non unionized workers. As before, differences in the valuation of education and experience explain a higher proportion of the gap than differences in the composition of the workforce. Again the results, controlling for selectivity, suggest that the actual difference in the valuation of measured skills between large and small firms is greater than implied by the estimates that ignore the selectivity effect. The overall size-wage gap, as well as the gaps associated with education and experience, like the size-wage gap for college educated workers, systematically smaller than those computed over the sample of non unionised workers. This is consistent with the tendency for unions to reduce wage inequalities.

Also, as before, differences in workforce composition seem most important in explaining the size-wage gap for college educated workers (in Canada) and workers with no secondary schooling (in both countries). For unionized college educated workers in the U.S, however, differences in the valuation of a college education between large and small firms appears to be more important than workforce composition effects. For workers with intermediate levels of education, on the other hand, differences in wages (across large and small firms) seem to be driven by differences in the valuation of these skills (i.e. different wage policies), although workforce composition effects also appear to be important for high school educated workers in the U.S. case. As before, these observations are robust to inclusion of controls for selectivity.

Overall, there is strong evidence of non random allocation of workers into large and small firms in both Canada and the United States.[22] The selection pattern, that workers with high quality along unobserved dimensions self select into smaller firms, is similar for both countries and consistent with earlier findings by Idson and Feaster (1990) who used U.S. data from the May CPS for the year 1979. This suggests that the selection pattern has been stable over time. From the nature of the selection pattern, with evidence of negative selection in large firms and positive selection in small firms, one can also conclude that small employers seem to reward unmeasured aspects of skills as captured by the positive effect of the inverse Mills ratio while large companies do not seem to reward such skills as highly. Examples of these unmeasured skills may include a propensity to operate in a work environment that is more prone to fast

[22]Note that the findings are robust to dropping the exclusion restrictions and identifying the selectivity terms through non linearities implied by the use of the normal distribution although the estimates of positive selection in small firms becomes only weakly significant. The results are available upon request.

changes, or dimensions of ability related to creativity and autonomy in decision taking.

5 Conclusion

This paper compares U.S. and Canadian wage structures by firm size using cross-sectional data from the Labour Force Survey for Canada and the March Current Population Survey for United States for the year 1998. It is assumed that large and small firms have different working environments in which the various dimensions of workers' skills (measured and unmeasured) may not be identically productive. The objective is to test for the possibility of different returns to education and experience as well as examine the role played by unmeasured skills in driving the allocation of workers across firms of different sizes.

The results show evidence of non random selection of workers into firms of different sizes for both countries in both sectors. In the non unionised sector, the selection is found to be strongly negative in large firms in both countries and positive in small firms. The observed selection pattern implies that workers in large firms would be on average of lower quality in terms of unmeasured aspects of skills whereas those in small firms would be of higher quality. The selection pattern is similar for both countries and consistent with earlier findings by Idson and Feaster (1990) who used U.S. data from the May CPS for the year 1979.

The analysis of the size-wage gap decomposition shows that large firms tend to put more weight on the valuation of measured skills than small firms do. This pattern is robust to controlling for self selection, and in fact, once selectivity effects are incorporated it appears that rewards to measured skills constitute the main source of higher wages in large firms. This finding combined with the result on the selection pattern is consistent with an explanation of the differences in wage policies between large and small firms based on differences in monitoring costs. A similar finding based on the National Longitudinal Survey for the year 1969 was found in Garen (1985). The author compares the returns to education and IQ scores in large and small firms and find that large firms tend to reward more education than less directly observable ability proxied by the IQ scores while small firms reward more ability than education.

Another result worth emphasizing is the similarity in the selection pattern for unionised and non unionised workers in both countries. The similarity implies that the non random

selection of workers into large and small employers seems to operate independently of the non random selection associated with union and non union status. A more rigorous way of testing these independent effects would be to estimate and compare the effects of the inverse Mills ratio estimated from a multinomial selection equation with the four choices consisting in unionised and non unionised workers in small and large companies. However the greater number of choices available to workers complicates the task of defining the process for workers selection and identifying the different inverse Mills ratios.

References

[1] Brown, C. and J. Medoff (1989) "The Employer Size-Wage Effect," *Journal of Political Economy* **97**, 1027–1059.

[2] D., Neal and S. Rosen (2000) "Theories of the Distribution of Labor Earnings," in *Handbook of Income Distribution*, volume 1. Elsevier.

[3] Dickens, W. T. and L. F. Katz (1987) "Inter-industry Wage Differences and Industry Characteristics," in Lang, K. and J. Leonards, eds., *Unemployment and the Structure of Labor Markets*. London: Basil Blackwell.

[4] Freeman, R. B. (1980) "Unionism and the Dispersion of Wages," *Industrial and labour Relations review* **34**, 3–23.

[5] Garen, J. (1985) "Worker Heterogeneity, Job Screening, and Firm Size," *Journal of political Economy* **93**, 715–739.

[6] Gibbons, R. and L. Katz (1992) "Does Unmeasured Ability Explain Inter-Industry Wage Differentials?," *Review of Economics Studies* **59**, 515–535.

[7] Glaeser, E. L. and D. C. Maré (2001) "Cities and Skills," *Journal of Labor Economics* **19**, 316–342.

[8] Idson, T. and D. Feaster (1990) "A Selectivity Model of Employer Size Wage Differentials," *Journal of Labor Economics* **8**, 99–122.

[9] Krueger, A. and L. Summers (1988) "Efficiency Wages and the Inter-Industry Wage Structure," *Econometrica* **56**, 259–293.

[10] Lemieux, T. (1998) "Estimating the Effects of Unions on Wage Inequality in a Panel Data Model with Comparative Advantage and Nonrandom Selection," *Journal of Labor Economics* **16**(2), 261–291.

[11] Maddala, G. S. (1977a). *Self-selectivity problems in Econometric Models*, chapter Applications of Statistics, pages 351–366. Amsterdam: North-Holland.

[12] Martinello, F. and R. Meng (1992) "Effects of Labor Legislation and Industry Characteristics on Union Coverage," *Industrial and Labor Relations Review* **46**(1), 176–190.

[13] Moranto, C. L, "Corporate Characteristics and Union Organizing," *Industrial Relations, year = 1988, volume = 27, number = 3, pages = 352-370.*

[14] Morissette, R. (1993) "Canadian Jobs and Firm Size: Do Smaller Firms Pay Less?," *Canadian Journal of Economics* **XXVI**(1), 159–173.

[15] Oi, W. and T. Idson (1999) "Firm Size and Wages," in *Handbook of Labor Economics*, volume 3B. Elsevier.

[16] Pearce, J. E. (1990) "Tenure, Unions, and the Relationship between Size and Wages," *Journal of Labor Economics* **8**(2), 251–269.

[17] Reilly, K. (1993) "Human Capital and Information, The Employer Size-Wage Effect," *Journal of Human Resources* **XXX**(1), 1–18.

[18] Roy, A. D. (1951) "Some Thoughts on the Distribution of Earnings," *Oxfors Economic Papers (New Series)* **3**, 135–146.

[19] Sattinger, M. (1993) "Assignment Models of the distribution of Earnings," *Journal of Economic Literature* **31**(2), 830–880.

Table 1: Firm Size Wage Differentials[a], Canada-United States, 1998

Canada[b]	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
Large Firm	0.200***	0.135***	0.105***	0.089***	0.076***	0.023***	0.013***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(.004)	(0.004)
University		0.615***	0.607***	0.594***	0.383***	0.376***	0.371***
		(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Post secondary		0.334***	0.327***	0.320***	0.223***	0.219***	0.204***
		(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Secondary		0.207***	0.207***	0.201***	0.145***	0.142***	0.127***
		(0.005)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
Experience		0.035***	0.032***	0.031***	0.027***	0.027***	0.018***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Union			0.137***	0.106***	0.137***	0.129***	0.080***
			(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Large Establishment						0.127***	0.113***
						(0.006)	(0.006)
Tenure							0.029***
							(0.001)
Constant	2.660***	1.989***	1.987***	2.093***	2.097***	2.106***	2.139***
	(0.003)	(0.008)	(0.008)	(0.008)	(0.011)	(0.012)	(0.012)
Industry	No	No	No	Yes	Yes	Yes	Yes
Occupation	No	No	No	No	Yes	Yes	Yes
R2	0.04	0.32	0.34	0.36	0.45	0.45	0.49
United States[b]	(I)	(II)	(III)	(IV)	(V)		
Large Firm	0.246***	0.158***	0.158***	0.152***	0.133***		
	(0.008)	(0.006)	(0.007)	(0.007)	(0.007)		
College		0.869***	0.869***	0.852***	0.613***		
		(0.016)	(0.016)	(0.016)	(0.018)		
Ass. College		0.550***	0.549***	0.520***	0.363***		
		(0.018)	(0.018)	(0.018)	(0.018)		
High School		0.379***	0.379***	0.355***	0.274***		
		(0.014)	(0.014)	(0.014)	(0.014)		
Experience		0.041***	0.041***	0.039***	0.038***		
		(0.001)	(0.001)	(0.001)	(0.001)		
Union			0.033***	0.030***	0.079**		
			(0.013)	(0.013)	(0.013)		
Constant	2.477***	1.505***	1.505***	1.408***	1.320***		
	(0.007)	(0.029)	(0.029)	(0.043)	(0.009)		
Industries	No	No	No	Yes	Yes		
Occupations	No	No	No	No	Yes		
R2	0.03	0.27	0.27	0.29	0.33		

a-Based on a sample of 65921 observations for Canada and 25699 for the United States. Dependent variable is log of hourly wages. Also includes experience squared. Standard Errors in parenthesis.

b- The omitted categories are no high school, small firms in natural resources related industry and job.

Table 3: Wage Structure by Firm Size[a]

Variables[b] Interacted with	Size	**Canada** Coeff	χ^2-test[c]	**USA** Coeff	χ^2- test[c]
University					
/ College	Large	0.334***	9.97	0.538***	3.15
		(0.014)	(0.001)	(0.022)	(0.076)
	Small	0.385***		0.586***	
Post Secondary		(0.010)		(0.018)	
/ Asso. college	Large	0.196***	4.87	0.294***	0.85
		(0.012)	(0.027)	(0.024)	(0.356)
	Small	0.227***		0.323***	
Secondary		(0.018)		(0.021)	
/ High School	Large	0.128***	2.28	0.202***	2.80
		(0.011)	(0.131)	(0.020)	(0.094)
	Small	0.149***		0.243***	
No Secondary		(0.008)		(0.014)	
/ No High School	Large	2.201***	19.36	1.810***	4.22
		(0.022)	(0.000)	(0.032)	(0.040)
	Small	2.117***		1.740***	
		(0.018)		(0.028)	
Experience	Large	0.027***	1.59	0.034***	7.66
		(0.001)	(0.207)	(0.001)	(0.006)
	Small	0.026***		0.026***	
		(0.000)		(0.001)	

a-Based on a sample of 39225 observations for Québec, Ontario and British Columbia and 25699 observations for the U.S.. Standard errors in parenthesis.

b-Dependent variable is log hourly wages. Estimations without constant term. Also includes experience squared, industry, gender, marital status, public sector, union and occupation dummies. The omitted industry and occupation categories are related to natural resources activities.

c-Test of equality of slopes between large and small firms, p-value in parenthesis.

Table 4a: Wage Structure by Firm Size, *Non Unionised* Firms[a]

Variables[b]		**Canada**		**USA**	
Interacted with	Size	Coeff	χ^2-test[c]	Coeff	χ^2- test[c]
University / College	Large	0.436***	5.30	0.487***	0.28
		(0.022)	(0.012)	(0.022)	(0.597)
	Small	0.380***		0.501***	
Post Secondary		(0.013)		(0.019)	
/ Asso. college	Large	0.267***	2.48	0.255***	0.16
		(0.019)	(0.115)	(0.023)	(0.689)
	Small	0.232***		0.242***	
Secondary		(0.010)		(0.021)	
/ High School	Large	0.189***	2.30	0.165***	0.19
		(0.019)	(0.129)	(0.020)	(0.661)
	Small	0.157***		0.176***	
No Secondary		(0.010)		(0.015)	
/ No High School	Large	2.01***	3.64	1.902***	0.68
		(0.029)	(0.056)	(0.043)	(0.409)
	Small	2.06***		1.874***	
		(0.022)		(0.040)	
Experience	Large	0.034***	13.12	0.030***	8.29
		(0.002)	(0.000)	(0.001)	(0.004)
	Small	0.027***		0.023***	
		(0.000)		(0.002)	

Table 4b: Wage Structure by Firm Size, *Unionised* Firms[a]

Variables[b]		**Canada**		**USA**	
Interacted with	Size	Coeff	χ^2-test[c]	Coeff	χ^2- test[c]
University / College	Large	0.259***	20.38	0.345***	0.94
		(0.017)	(0.000)	(0.122)	(0.332)
	Small	0.353***		0.486***	
Post Secondary		(0.016)		(0.099)	
/ Asso. college	Large	0.155***	4.18	0.142	2.65
		(0.014)	(0.041)	(0.119)	(0.104)
	Small	0.192***		0.397***	
Secondary		(0.012)		(0.111)	
/ High School	Large	0.097***	1.46	0.056	1.43
		(0.013)	(0.227)	(0.108)	(0.232)
	Small	0.118***		0.222***	
No Secondary		(0.012)		(0.084)	
/ No High School	Large	2.603***	31.25	2.081***	0.22
		(0.030)	(0.000)	(0.186)	(0.642)
	Small	2.436***		1.974***	
		(0.029)		(0.149)	
Experience	Large	0.021***	2.76	0.024***	0.10
		(0.001)	(0.096)	(0.008)	(0.751)
	Small	0.024***		0.020**	
		(0.001)		(0.009)	

a-The sample of non unionised workers has 23894 observations for Canada (Québec, Ontario and British Columbia) and 24524 for the U.S.. The sample of unionised workers has 24856 observations for the Canadian provinces and 1175 for the U.S.
b-Dependent variable is log hourly wages. Estimations without constant term. Also includes experience squared, industry, gender, marital status, public sector and occupation dummies. The omitted industry and occupation categories are related to natural resources activities.
c-Test of equality of slopes between large and small firms, p-value in parenthesis.

Table 5a: Heckman Two-Step Estimations[a], Canada-United States, Non Unionised Firms, Private Sector

	Canada				United States			
Variables[b]	> 500 Uncorrected	≤ 500	> 500 Corrected	≤ 500	> 500 Uncorrected	≤ 500	> 500 Corrected	≤ 500
University	0.427***	0.364***	0.264***	0.329***	0.545***	0.563***	0.401***	0.457***
/ College	(0.025)	(0.014)	(0.052)	(0.027)	(0.026)	(0.021)	(0.050)	(0.041)
Post Secondary	0.268***	0.231***	0.201***	0.219***	0.300***	0.310***	0.199***	0.240***
/ Asso. College	(0.021)	(0.010)	(0.028)	(0.012)	(0.027)	(0.023)	(0.041)	(0.033)
Secondary	0.202***	0.154***	0.117***	0.139***	0.209***	0.248***	0.118***	0.186***
/ High School	(0.020)	(0.010)	(0.030)	(0.014)	(0.022)	(0.015)	(0.035)	(0.025)
No Secondary	1.96***	1.89***	3.04***	1.81***	1.29***	1.40***	1.99***	1.38***
/ No High School	(0.061)	(0.037)	(0.314)	(0.062)	(0.088)	(0.068)	(0.230)	(0.069)
Experience	0.059***	0.054***	0.088***	0.061***	0.055***	0.049***	0.054***	0.048***
	(0.009)	(0.005)	(0.012)	(0.007)	(0.010)	(0.009)	(0.010)	(0.009)
Experience^2	-0.002***	-0.002***	-0.004***	-0.002***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mills Ratio[c]			-0.670***	-0.246*			-0.379***	-0.307***
			(0.288)	(0.140)			(0.124)	(0.102)
N	5540	16747			9811	10699		

a-Based on a sample of 22287 observations for Québec, Ontario and British Columbia and 20510 observations for the United States.
b-Dependent variable is log of hourly wages. Experience squared, race, married, large city, industry and occupation dummies are included in the wage equation for both countries. The omitted industry is trade wholesale.
c-Standard errors computed using bootstrapping.

Table 5b: Heckman Two-Step Estimations[a], United States, Unionised Firms

Variables[b]	Canada				United States			
	> 500 Uncorrected	≤ 500	> 500 Corrected	≤ 500	> 500 Uncorrected	≤ 500	> 500 Corrected	≤ 500
University	0.300***	0.322***	0.200***	0.260***	0.372***	0.371***	0.360***	0.241*
/ College	(0.019)	(0.018)	(0.029)	(0.029)	(0.112)	(0.126)	(0.112)	(0.144)
Post Secondary	0.182***	0.173***	0.119***	0.139***	0.160	0.407***	0.147	0.279**
/ Asso. College	(0.014)	(0.012)	(0.019)	(0.018)	(0.110)	(0.104)	(0.110)	(0.126)
Secondary	0.119***	0.107***	0.049**	0.069***	0.072	0.201**	0.059	0.059
/ High School	(0.014)	(0.012)	(0.020)	(0.019)	(0.099)	(0.088)	(0.102)	(0.109)
No Secondary	2.38***	2.35***	3.00***	2.23***	2.24***	2.13***	2.27***	1.88***
/ No High School	(0.066)	(0.048)	(0.153)	(0.061)	(0.411)	(0.477)	(0.399)	(0.531)
Experience	0.054***	0.057***	0.061***	0.061***	0.043	0.060	0.042	0.054
	(0.009)	(0.009)	(0.011)	(0.009)	(0.063)	(0.072)	(0.063)	(0.073)
Experience^2	-0.002***	-0.002***	-0.003***	-0.002***	-0.001	0.001	0.004	0.005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.005)	(0.004)	(0.005)
Mills Ratio[c]			-0.474***	-0.315***			-0.057	-0.369
			(0.114)	(0.144)			(0.212)	(0.355)
N	7442	7889			888	287		

a-Based on a sample of 15427 observations for Québec, Ontario and British Columbia and 1175 observations for the United States.
b-Dependent variable is log of hourly wages. Experience squared, race, married, large city, industry and occupation dummies are included in the wage equation for both countries. The omitted industry is trade wholesale.
c-Standard errors computed using bootstrapping.

Table 6a: Size-Wage Differential Decomposition[a], Canada-United States, Non Unionised Firms, Private Sector

	Without Self-Selection			With Self-Selection				
	E (Endowments)	C (Coefficients)	E+C	E (Endowments)	C (Coefficients)	E+C	S (Selectivity)	T (Total)
Canada								
University	0.221	0.023	0.244	0.306	0.207	0.513		
Post Secondary	-0.039	0.035	-0.003	-0.056	0.415	0.359		
Secondary	-0.014	0.035	0.021	-0.020	0.374	0.353		
No Secondary	-0.135	0.011	-0.124	-0.209	0.197	-0.011		
Experience	-0.041	0.089	0.049	-0.061	0.532	0.471		
All[b]	0.077	0.083	0.160	-0.017	1.077	1.061		
Selectivity[c] (S)							-0.901	
Raw Differential								0.160
Total Net of Selectivity								1.061
United States								
College	0.152	-0.030	0.121	0.198	0.128	0.326		
Asso. College	0.007	-0.011	-0.003	0.011	0.050	0.061		
High School	-0.015	-0.081	-0.097	-0.022	0.291	0.269		
No High School	-0.099	-0.017	-0.116	-0.154	0.091	-0.062		
Experience	-0.007	0.134	0.126	-0.007	0.131	0.124		
All[b]	0.093	0.129	0.222	0.051	0.689	0.740		
Selectivity[c] (S)							-0.518	
Raw Differential								0.222
Total Net of Selectivity								0.740

a-Based on separate regressions of log wages for large and small firms on all previously mentioned explanatory variables are included. Regressions with exclusions of a constant term. Decomposition formula : $(\overline{X}_{LNU} - \overline{X}_{SNU})\beta_{LNU} + (\beta_{LNU} - \beta_{SNU})\overline{X}_{SNU}$

b-This decomposition excludes the selectivity term. It is based on all the explanatory variables used in previous estimations except the Mills ratio.

c-The selectivity term is computed based on the formula: $(\overline{\lambda}_{LNU} - \overline{\lambda}_{SNU})\gamma_{LNU} + (\gamma_{LNU} - \gamma_{SNU})\overline{\lambda}_{SNU}$, where λ is the Mills ratio.

Table 6b: Size-Wage Differential Decomposition[a], Canada-United States, Unionised Firms

	Without Self-Selection			With Self-Selection				
	E (Endowments)	C (Coefficients)	E+C	E (Endowments)	C (Coefficients)	E+C	S (Selectivity)	T (Total)
Canada								
University	0.274	0.000	0.275	0.329	0.122	0.451		
Post Secondary	-0.034	0.012	-0.022	-0.041	0.273	0.232		
Secondary	-0.023	0.009	-0.014	-0.028	0.204	0.176		
No Secondary	-0.190	0.005	-0.185	-0.240	0.146	-0.094		
Experience	-0.004	-0.077	-0.082	-0.005	-0.020	-0.025		
All[b]	0.061	0.090	0.151	0.050	0.769	0.819		
Selectivity[c] (S)							-0.668	
Raw Differential								0.151
Total Net of Selectivity								0.819
United States								
College	-0.004	0.029	0.025	-0.003	0.139	0.135		
Asso. College	-0.000	-0.013	-0.013	-0.000	0.023	0.023		
High School	0.182	-0.012	-0.170	0.184	0.197	0.381		
No High School	-0.173	0.013	-0.159	-0.175	0.049	-0.126		
Experience	-0.042	0.393	0.351	-0.041	0.078	0.037		
All[b]	0.006	0.067	0.073	-0.001	0.531	0.529		
Selectivity[c] (S)							-0.456	
Raw Differential								0.073
Total Net of Selectivity								0.529

a-Based on separate regressions of log wages for large and small firms on all previously mentioned explanatory variables are included. Regressions with exclusions of a constant term. Decomposition formula : $(\overline{X}_{LU} - \overline{X}_{SU})\beta_{LU} + (\beta_{LU} - \beta_{SU})\overline{X}_{SU}$

b-This decomposition excludes the selectivity term. It is based on all the explanatory variables used in previous estimations except the Mills ratio.

c-The selectivity term is computed based on the formula: $(\overline{\lambda}_{LU} - \overline{\lambda}_{SU})\gamma_{LU} + (\gamma_{LU} - \gamma_{SU})\overline{\lambda}_{SU}$, where λ is the Mills ratio.

APPENDIX A1: Descriptive Statistics by Firm Size[a], (LFS 98)

Variables	Total ($N = 69521$)	Large Firm (> 500)	Small Firm (≤ 500)
Large Firm	33.3	1	0
Small Firm	66.7	0	1
Large Establishment	-	-	-
Small Establishment	-	-	-
Union	34.9	50.2	27.4
Public	18.4	31.1	12.0
University	20.2	26.9	16.9
Post Secondary	35.4	34.6	35.9
Secondary	29.6	28.3	30.3
No Secondary	14.8	10.2	16.9
Age 20-29	23.5	20.1	25.2
Age 30-39	31.0	29.9	31.6
Age 40-49	28.3	31.2	26.6
Age 50-65	17.2	18.8	16.6
Experience	20.5	21.0	20.2
Tenure (years)	7.6	9.4	6.7
Female	40.2	44.3	41.3
Married	65.2	69.5	66.5
Log(wage)[b]	2.73	2.86	2.67

a-Based on a sample of 69521 observations.
b-Hourly wages reported.

APPENDIX A2: Descriptive Statistics by Firm Size[a], (CPS 98)

Variables	Total ($N = 28121$)	Large Firm (> 500)	Small Firm (≤ 500)
Large Firm	54.8	1	0
Small Firm	45.2	0	1
Large Establishment	-	-	-
Small Establishment	-	-	-
Union	5.1	6.2	2.4
Public	17.8	25.2	7.5
College	32.1	32.6	22.3
Associate college	9.2	9.6	9.1
High School	51.1	51.4	56.5
Less than HS	7.6	6.4	12.1
Age 20-29	19.5	17.7	21.5
Age 30-39	29.6	29.5	29.7
Age 40-49	28.7	30.1	27.2
Age 50-65	21.9	22.4	21.3
Experience	21.9	21.8	21.2
Female	40.2	44.8	39.2
Married	65.2	63.5	62.2
Log(wage)[b]	2.79	2.85	2.72

a-Based on a sample of 25812 observations.
b-hourly wages computed.

APPENDIX B: Test of Validity of Exclusion Restrictions

The use of the interactions between a worker's city size and industry as exclusion restrictions implicitly assumes that the direct impact of city size on a worker's wage should not differ by industry. That is for the average city size, there is no additional city size impact by industry. The next table shows the results of a test of the validity of that assumption. The methodology consists in augmenting a standard wage equation by adding interactions of a dummy for living in a large city (more than 500 thousand individuals) with the worker's industry of employment. If, as assumed, city size does not affect workers' wages differently across industries, these additional dummies should not be significant. Tables B.1 and B.2 show the results for the sample of non unionised and unionised workers.

Table B.1: Cross-Industry Effects of Living in a Large City[a] on (log) Hourly Wages Non Unionised, Private Sector[b]

Variables[c]	Canada			USA	
	Coeff	F-test[d]	F-test[d]	Coeff	F- test[d]
Primary*Large City	0.070	"		-0.124	
	(0.049)			(0.085)	
Non Durable*Large City	-0.118***		"	-0.131***	
	(0.024)			(0.041)	
Durable*Large City	-0.113***		"	0.019	"
	(0.024)			(0.037)	
Transport*Large City	0.007	"		-0.015	"
	(0.029)			(0.043)	
Trade (Retail Sale)*Large City	0.018	"		-0.043	"
	(0.024)			(0.038)	
Finance*Large City	-0.006	"		0.059	"
	(0.025)			(0.041)	
Services*Large City	0.007	"		0.024	"
	(0.021)			(0.035)	
F-test All Industries	15.92			7.11	
(p-value)	(0.000)			(0.000)	
F-test partial		0.49	0.04		1.99
(p-value)		(0.785)	(0.842)		(0.077)

a-Large city is defined as a dummy equal to one for more than 500 thousands individuals in the U.S. case and for Vancouver, Toronto and Montreal for Canada.
b-Based on a sample of 22287 observations for Canada (BC, QC and Ontario) and 20510 for the U.S.
c-Dependent variable is log hourly wages. Also includes education, a
quadratic in experience, gender, race, marital status, occupation, large city, large firm and industry dummies. The omitted industry is trade wholesale.
d-Test of joint equality to zero of the interaction effects.

APPENDIX B (Continued): Test of Validity of Exclusion Restrictions

Table B.2 Within Industry Effects of Living in a Large City[a] on (log) Hourly Wages Unionised Sector[b]

Variables[c]	Canada			USA	
	Coeff	F-test[d]		Coeff	F- test[d]
Primary*Large City	0.039	”		-0.426*	”
	(0.099)			(0.245)	
Non Durable*Large City	-0.160***		”	-0.295	”
	(0.049)			(0.201)	
Durable*Large City	-0.109**		”	0.162	”
	(0.047)			(0.193)	
Transport*Large City	-0.043	”		-0.263	”
	(0.046)			(0.192)	
Trade (Retail Sale)*Large City	-0.062	”		-0.257	”
	(0.053)			(0.227)	
Finance*Large City	0.048	”		0.154	”
	(0.058)			(0.253)	
Services*Large City	-0.066	”		-0.103	”
	(0.045)			(0.189)	
Government*Large City	-0.045	”		0.134	”
	(0.046)			(0.199)	
F-test All Industries	4.37			1.43	
(p-value)	(0.000)			(0.190)	
F-test partial		1.79	2.98		
(p-value)		(0.100)	(0.084)		

a-Large city is defined as a dummy equal to one for more than 500 thousands individuals in the U.S. case and for Vancouver, Toronto and Montreal for Canada.
b-Based on a sample of 15427 observations for Canada (BC, QC and Ontario) and 1175 for the U.S.
c-Dependent variable is log hourly wages. Estimations without constant term. Also includes education, a quadratic in experience, gender, marital status, occupation and industry
dummies. The omitted industry is trade wholesale.
d-Test of joint equality of the interaction effects.

APPENDIX C: Heckman Two-Step Estimations[a], United States, CPS Pooled data 1997-1999

Sector		**Non Unionised Private**				**Unionised**		
Variables[b]	> 500 Uncorrected	≤ 500	> 500 Corrected	≤ 500	> 500 Uncorrected	≤ 500	> 500 Corrected	≤ 500
University	0.509***	0.497***	0.419***	0.428***	0.346***	0.367***	0.299***	0.273***
/ College	(0.013)	(0.011)	(0.027)	(0.023)	(0.052)	(0.064)	(0.063)	(0.083)
Post Secondary	0.287***	0.272***	0.221***	0.223***	0.237***	0.275***	0.182***	0.164**
/ Asso. College	(0.014)	(0.012)	(0.022)	(0.019)	(0.050)	(0.064)	(0.065)	(0.086)
Secondary	0.200***	0.202***	0.147**	0.163***	0.137***	0.195***	0.086	0.095
/ High School	(0.011)	(0.009)	(0.018)	(0.014)	(0.045)	(0.048)	(0.060)	(0.065)
No Secondary	1.54***	1.64***	2.03***	1.63***	1.98***	1.96***	2.28***	1.89***
/ No High School	(0.055)	(0.038)	(0.139)	(0.039)	(0.215)	(0.165)	(0.300)	(0.166)
Experience	0.047***	0.043***	0.045***	0.041***	0.006	0.028	0.001	0.034
	(0.005)	(0.005)	(0.006)	(0.005)	(0.033)	(0.027)	(0.034)	(0.027)
Experience^2	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)
Mills Ratio[c]			-0.272***	-0.203***			-0.258*	-0.353**
			(0.070)	(0.065)			(0.151)	(0.154)
N	29220	30319			2736	955		

a-Based on a sample of 59605 observations for the private non unionised sector and 3702 observations for the unionised sector.
b-Dependent variable is log of hourly wages. Experience squared, race, married, large city, industry and occupation dummies and year dummies are included in the wage equation for both countries. The omitted industry is trade wholesale.
c-Standard errors computed using bootstrapping.